• EXECUTIVE SUMMARY

WATER RESOURCES AND PROBLEMS

Missouri has an area of 69,000 square miles and a population of 5.36 million people. Most of the human population is concentrated on opposite sides of the state in the Kansas City and St. Louis metro areas, leaving most of the state and its waters rural in nature. Surface and ground water in Missouri are quite varied in quantity and quality, corresponding closely with geology and land use.

Northern and Western Missouri

Northern and Western Missouri, originally prairie land, is now used primarily for crop and livestock production and is underlain by bedrock containing several relatively impermeable shale and clay layers. Surface waters are more turbid and are greatly affected by high rates of sediment deposition. These deposits, caused by soil erosion and channel modification, result in poor aquatic habitat due to the fine, unstable materials of stream bottoms. About 7,300 miles of classified streams, mostly in this part of the state, suffer impairment due to these conditions, and in more than half these miles, streams are further impaired by either periodic water loss or channelization, which is the modification of a stream into a straight, narrow ditch.

Rivers and reservoirs used as drinking water supplies often contain herbicides. Drinking water standards for atrazine or health advisory levels for cyanazine are exceeded in some public water supplies served by reservoirs. Several other herbicides are occasionally found in drinking water reservoirs but at concentration below health advisory levels.

The quality of ground waters in northern and western Missouri is influenced by the geology of the area. The public water supply sources include reservoirs and wells. The wells obtain water from glacial drift deposits primarily in portions of north-central and western Missouri. Wells in western Missouri, south of Kansas City, obtain water from limestone aquifers except for the extreme western limits of Missouri near the state border with Kansas. Private water supplies obtain water from glacial drift deposits and from underlying limestone bedrock in portions of northwestern, central, eastern and northeastern Missouri. However, deep bedrock wells in many north-central and northwestern Missouri locations draw water from aquifers that are too mineralized for drinking water purposes. About one-third of private wells in this portion of Missouri exceed the drinking water standard for nitrate, one-third exceed bacterial standards for drinking water and about 2 percent exceed drinking water standards for pesticides. This contamination is often caused by localized surface contamination of the wellhead and does not represent widespread contamination of the underground aquifer. Deeper aquifers are usually protected from surface contamination by impermeable strata.

The Ozark Plateau

The Ozark Plateau, including the Springfield Plateau, is predominantly hilly topography. There are some very rugged portions as well as significant areas of gentle to almost flat landscape. The bedrock consisting of limestone, dolomite and sandstone yields ground water of excellent quality and adequate in supply for most urban, industrial and other needs. The soil and subsoil materials have developed from weathering of the bedrock formations and is generally 20 to 80 feet in thickness.

Some areas have extremely thin soils and other locations where weathering has been extensive have thickness of 100 feet and more. The soil and subsoil materials have moderate to high infiltration rates that contribute to the recharge of ground water supplies. Ozark streams are generally clear with baseflows well sustained by many seeps and springs. Some streams and reservoirs in the Ozarks are becoming nutrient and algae enriched due to increasing human population and domestic animal production in some watersheds.

Ground water contamination risks are moderate to high due to the permeabilities of the soil and bedrock. Any number of surface activities including agricultural and suburban-urban development, waste water disposal, mining, stormwater runoff, lawn care, and improper well and individual waste disposal practices all pose threats to surface water and ground water quality. Overall water quality remains good in large areas of the Ozarks dominated by forest and other less intensive land uses. Areas of more intensive land use such as urban-suburban areas and areas with many concentrated animal feeding operations typically have higher levels of nitrates.

Ground water is heavily relied upon for drinking water supply in this part of Missouri. Most municipalities in the southern half of the state rely on ground water for drinking water supply. The number of private drinking water wells state-wide is not known but probably is between 100,000 and 250,000 with a greater number of these wells being south of the Missouri River. The major ground water concern is the often rapid and unfiltered transmission of contaminated surface runoff or leachate from some septic tanks, underground storage tanks, landfills, dumps, liquid waste storage ponds, animal production and processing wastes through fractures or sinkholes directly into potable aquifers. Properly cased wells into deep aquifers rarely encounter water quality problems, but shallow or improperly cased wells are at risk.

In the Joplin area, the shallow bedrock aquifer has elevated levels of sulfate and several heavy metals due to mineralization of ground water in flooded mines. Some private wells in this area exceed drinking water standards for lead, cadmium or organic chemicals. Localized contamination of shallow private wells due to leaks, spills and improper disposal of industrial or commercial chemicals occur in the larger metro areas of Springfield and Joplin.

The Mississippi Embayment

Missouri=s southeastern corner is a large alluvial plain of the Mississippi River. Originally a vast system of wetlands, it has been drained and almost entirely converted to crop production. Almost all surface waters in the area are drainage ditches and are rated as only partially attaining beneficial uses because of degradation of aquatic habitat due to channelization. Channelization creates a homogenous, low quality aquatic habitat. Sloughing of the channel banks, which fill the channel bottoms, burying better habitat and leaving unstable substrate, is a problem.

Ground water is abundant due to high infiltration rates on these flat fields. Public water supplies that tap deeper aquifers provide good quality water, but shallow private wells commonly have nitrates and low levels of pesticides. The frequency of exceedence of drinking water standards for nitrates and pesticides in private wells is similar to northern Missouri, about 30 percent and 2 percent, respectively.

Alluvial Aquifers

The remaining major aquifer is the alluvial aquifer system of the major rivers of the state. In northern Missouri, where surface and deep aquifer supplies are unreliable, many towns depend on the alluvial aquifer of a large nearby stream. Landfills and industrial land use in Kansas City and St. Louis have historically been located on river floodplains and have caused local contamination of the Mississippi, Missouri and Meramec river aquifers in St. Louis and the Missouri River aquifer in Kansas City. Some municipal water supplies have been affected.

WATER POLLUTION CONTROL ACTIVITIES

Authority for enforcement of the Missouri Clean Water Law and for state regulations concerning water pollution resides in the Department of Natural Resources, Division of Environmental Quality. Authority for the regulation of pesticides rests with the Missouri Department of Agriculture, Plant Industries Division. Authority for the regulation of fisheries, forestry and wildlife rests with the Missouri Department of Conservation.

Point Source Controls

The number of miles of classified streams impaired by point source wastewater discharges has generally been decreasing since 1984, when state-wide data on stream quality became available. In 1984, 105 miles of classified stream were impaired by domestic or industrial waste waters, and only 42 miles in 1996, but that figure increased to 91 miles in 1998. This was due mainly to increased loads at the city of California South lagoons and elevated fecal coliform bacteria below the city of Springfield northwest wastewater plants. These two discharges are estimated to impair 39 miles of stream**.**

The Missouri Clean Water Commission has revised its regulations to bring concentrated animal feeding operations (CAFOs) into the point source permit program, consistent with federal requirements. There has been unprecedented growth in CAFOs in Missouri during the past few years. Where manure spills and fish kills from CAFOs occur, there can be serious water quality problems. This report notes 18.7 miles of classified streams polluted by chronic manure spills over several years. Assuring proper management of animal manure is a high priority of the department.

Nonpoint Source Controls

Control of nonpoint water pollution sources such as runoff from farms, cities, mining areas and construction sites is still essentially a voluntary program. Regulations are in place to prevent leakage from underground storage tanks and for the secondary containment of bulk agricultural chemical storage sites. Large sand and gravel mining operations require a general permit for storm water and smaller operations have been provided with guidelines for best management practices (BMPs), in addition to the 404 permit required of some sand and gravel operations. Control of many nonpoint sources, such as agricultural erosion from cropland and pasture, runoff of fertilizer, pesticides and animal waste, is implemented voluntarily through a partnership between federal, state and local governments, universities, private groups and individual landowners to improve nonpoint source control and often monitor water quality results.

Programs with dedicated funding sources have worked best. A tax on coal has funded reclamation of abandoned coal mined lands nationwide. Fourteen years of such reclamation in Missouri has reduced the number of stream miles impaired by acid mine drainage from about 100 down to 42. A state sales tax for soil erosion control started providing funds for watershed level soil erosion control programs in 1985. This program, coupled with federal soil conservation programs, is reducing soil erosion in Missouri based on the findings of periodic National Resource Inventories. On the prairie lands of northern and western Missouri, which are now used primarily for pasture and row crop agriculture, total soil erosion has been reduced about 40% between 1982 and 1992. On the pasture and row crop lands of the prairie-Ozark border, the reduction has been 38% and in the Mississippi Embayment of southeast Missouri and in the Ozarks 14% during the same period.

STATE CONCERNS

The state of Missouri has many concerns about the trends in the state's water quality. While some water quality problems stem from historical changes in watersheds 50 to 100 years ago, newer activities can have equally detrimental impacts. Below are listed the general types of water quality problems facing the state today.

! Channelization has caused aquatic habitat degradation in 17 percent of Missouri's streams. Few streams are being newly channelized, but streams that were channelized many years ago still provide poor aquatic habitat, and the streams still contribute to flooding, high water velocities and streambank erosion.

- Eutrophication of large, recreationally important reservoirs appears to be increasing. Heavy residential development around portions of Lake of the Ozarks and Table Rock Lake threatens water quality in many small coves and shoreline areas. The large size of these lakes and rugged local topography make centralized collection and treatment systems for wastewater difficult and expensive, but worth pursuing given the value of the water resource. Nutrient problems from waste water treatment plants and septic tanks are being aggravated by increasing concentrated animal production in the watersheds of these lakes.

- Mercury levels in fish in Arkansas and Missouri appear to be increasing over time, with fish consumption health advisories in place in southern Arkansas. Atmospheric deposition is suspected as a major cause.

- Abandoned lead-zinc mines and their tailings continue to impact waters decades after mining has ceased. State and federal Superfund programs are addressing some of these concerns. But, long-term impacts are expected to remain. Although new mineral extraction operations would be managed under state permits, areas of the state that are very sensitive to disruption may be further investigated for mining potential.

- Additional ground water protection measures are needed. Missouri now has in place programs that register and inspect underground storage tanks and oversee the cleanup of leaking underground tank sites, programs for wellhead protection, sealing of abandoned wells and closing of hazardous waste sites. A complete ground water protection program would also include a ground water monitoring network and educational programs for those involved in the application of farm chemicals, transporters of hazardous materials and the general public. Missouri is working toward such a comprehensive ground water monitoring program.

- Large concentrated animal feeding operations (CAFOs) continue to be located in Missouri. These facilities generate large amounts of animal manure and have the potential to cause serious water pollution problems. We are also concerned by cumulative impacts of numerous small animal production facilities on both surface and ground water.

- Evidence is accumulating that the fish and invertebrate communities of many streams in Missouri are suffering from the degraded quality of the aquatic habitat. Physical alterations of the channel, degraded conditions in the riparian zone and upland land use changes are all believed to be significant contributors to this problem.

- Continuing suburban development impacts streams by direct loss of stream channels by shortening, culverting, removal of riparian areas and other impacts associated with development and increased storm water flows.

- Similar to the ground water monitoring program needs noted above, the state has a relatively small amount of surface water quality monitoring relative to the size of the resource and the monitoring programs of other states.

TABLE 1. BENEFICIAL USE SUPPORT STATUS OF MISSOURI CLASSIFIED WATERS

There are 21,977.8 miles of classified streams (permanently flowing streams or streams which maintain permanent pools during dry weather) and approximately 30,000 miles of unclassified streams (streams which are without water during dry weather). There are 292,204 surface acres of classified lakes. The number of surface acres of small unclassified lakes has not been estimated.

STATUS	STREAM MILES	%	LAKE ACRES	%
Full Support	11,132.2	51	132,203	45
Full but Threatened	259.7	1	116,816	40
Partial Support	9,687.0	44	1,528	1
Not Supported	506.3	2	41,132	14
Not Assessed	392.6	2	0	0

Full Support: Water quality meets the needs of all uses that Missouri recognizes for a particular water such as protection of fish and other aquatic life (the water quality does not interfere with the ability of aquatic life to live, feed and reproduce), livestock and wildlife watering (the water will not cause disease or injury to livestock and wildlife using the water for drinking), drinking water supply (the water meets all state and federal standards as a drinking water supply source water), swimming (the water will not cause disease or injury to swimmers or others participating in water-based recreation who may accidentally swallow small amounts of water), irrigation (the water will not cause disease or injury to crops) or industrial water supply (the water will not cause excessive problems with corrosivity or mineral deposits in industrial piping and boilers), fish consumption (fish are safe to eat) and boating and canoeing.

Threatened: Water quality is presently adequate to maintain all recognized uses, but if harmful trends continue, only partial support may exist in the future.

Partial Support: Water quality has been impaired to the point that at least one of the recognized uses is affected.

Not Supported: Water quality is seriously affected to the point that at least one recognized use of the water has been lost.

Not Assessed: Streams in some urban and rural watersheds are believed to be significantly different in land use from monitored streams in their region so that their quality cannot be accurately inferred from monitored streams.

NOTE: In this report, "impaired" waters refers to waters rated as partial support or not supported.

TABLE 1A. INDIVIDUAL USE SUPPORT SUMMARY FOR CLASSIFIED STREAMS

BENEFICIAL USE	SIZE ASSESSED	FULL SUPPORT	PARTIAL SUPPORT	NON-SUPPORT	NOT ASSESSED	USE NOT APPLICABLE
STREAMS (MILES)						
AQUATIC LIFE	21,585.2	11,485.4	9,836.3	263.5	392.6	0.0
FISH CONSUMPTION	21,977.8	21,855.8	0.0	122.0	0.0	0.0
SWIMMING	5,411.9	5,364.2	0.0	47.7	12.5	16,553.4
DRINKING WATER	3,182.7	2,984.7	0.0	198.0	0.0	18,795.1
LAKES (ACRES)						
AQUATIC LIFE	292,204.0	289,484.0	50.0	2,670.0	0.0	0.0
FISH CONSUMPTION	259,615.0	258,675.0	0.0	940.0	32,589.0	0.0
SWIMMING	261,451.0	261,451.0	0.0	0.0	0.0	30,753.0
DRINKING WATER	99,119.0	61,084.0	1,478.0	36,557.0	1,669.0	191,416.0

Waters With Impairment of More than One Beneficial Use

Aquatic Life Protection and Drinking Water Supply Impairment

		Aquatic Life Protection	**Drinking Water Supply**
North Fabius River	82 miles	sediment	manganese
Middle Fabius River	57 miles	sediment	manganese
Salt River	29 miles	low dissolved oxygen	iron, manganese
Cannon Re-reg Pool	10 miles	low dissolved oxygen	manganese

Aquatic Life Protection and Human Health Fish Consumption

		Aquatic Life Protection	**Human Health Fish Consumption**
Blue River	2 miles	sediment	chlordane
Big River	40 miles	sediment	lead
Flat River Creek	5 miles	sediment	lead

TABLE 2. MAJOR WATER POLLUTION SOURCES IN MISSOURI CLASSIFIED WATERS
(Stream Miles or Lake Acres Impaired)

Source	Stream Miles Impaired	% of Total Miles	Lake Acres Impaired	% of Total Acres
Agriculture				
Soil Erosion	7,377	34		
Herbicides			26,557	9
Animal Manure	19			
Nutrients			1,478	1
Mining	179	1		
Hydromodification: Channelization	3,998	18		
Hydromodification: Reservoirs	40	<1	11,780	4
Contaminated Sediments and Urban Runoff	44	<1	825	<1
Domestic Point Source (Sewage)	91	<1	--	--
Unknown	--	--	115	<1

TABLE 3. MAJOR CONTAMINANTS IN MISSOURI CLASSIFIED WATERS

Contaminant	Stream Miles Impaired	% of Total Miles	Lake Acres Impaired	% of Total Acres
Sediment	7,601	34	--	--
Habitat Degradation	4,724	22	--	--
Organic Enrichment	404	2	--	--
Metals	329	1	10,000	3
Bacteria	48	<1	--	--
Sulfate	45	<1	--	--
Pesticides	24	<1	27,497	10
Suspended Solids	18	<1	--	--
Nutrients	4	<1	1,478	1
Low Dissolved Oxygen Water	--	--	1,780	1

NOTE: Many stream miles in Missouri are affected by more than one pollution source or pollutant; therefore, total miles/acres in Tables 2 and 3 can exceed miles/acres in Table 1.

CHAPTER 1. MISSOURI AND ITS WATER RESOURCES

Missouri has an area of 69,000 square miles and a population of 5.4 million people. Most of the population is concentrated along the border areas on opposite sides of the state in the Kansas City and St. Louis metro areas. Population as well as industrial and commercial activity in major urban areas has remained relatively stable for the past few decades. Patterns of rural land use have changed greatly in some areas. This is particularly notable in residential development around the larger cities, recreational development adjoining Lake Taneycomo and the eastern ends of Lake of the Ozarks and Table Rock Lake. Agricultural land use is characterized by the increasing development of large concentrated animal feeding operations in central, north central and southwestern Missouri.

Missouri has an impressive stream network that includes almost 22,000 miles of classified streams and over 290,000 surface acres in its 415 classified lakes. Three distinct regions exist within the state=s boundaries, and the particular geology and land use of each affect water quality. These areas are a prairie region, which is rolling land predominately used for row crop and pasture; the Ozarks, a hilly area that is mostly pasture and forest; and the Bootheel, a flat alluvial plain adjoining the Mississippi River in southeast Missouri, which is used mainly for row crop production.

Missouri=s Water Quality Standards (10 CSR 20-7.031) provide the names and locations of all classified streams and lakes. This state regulation defines over 3,500 individual stream and river segments and 415 lakes, lists which beneficial uses are assigned to each of these waters and defines the level of water quality necessary to meet each of these uses.

The remaining waters of the state--such as those in the upper portions of the stream network that do not have permanently flowing or standing water and a number of small lakes--are not listed in the Missouri Water Quality Standards and do not have beneficial uses assigned to them. These unclassified waters are protected by the general criteria in the Water Quality Standards. The general criteria say these waters must be free from such aesthetic problems as demolition debris, trash, tires, odor, discoloration or the presence of objectionable floating or deposited material. The general criteria also say the waters must be free from conditions harmful to livestock or aquatic life.

TABLE 4. MISSOURI'S WATER RESOURCES

Missouri Population (million people)	5.36
Surface Area (square miles)	69,000
Number of Major Basins	8
Classified Stream Miles	21,978
Unclassified Stream Miles (estimated)	30,000
Number of Classified Lakes	415
Total Classified Lake Surface Area (acres)	292,204
Freshwater Wetlands Area (acres)	643,000

CHAPTER 2. SURFACE WATER ASSESSMENT

DESCRIPTION OF MISSOURI=S CURRENT WATER QUALITY MONITORING PROGRAM

Purpose

The statewide water quality monitoring program has many purposes including

1. To characterize background or reference water quality conditions,
2. To better understand daily variations as well as variations related to flow event and seasonal water quality changes and their underlying processes,
3. To characterize aquatic biological communities and habitats and to distinguish between the impacts of water chemistry and habitat quality,
4. To assess time trends in water quality,
5. To characterize the impact of local and regional impacts of point and nonpoint source discharges on water quality,
6. To check for compliance with water quality standards or wastewater permit limits, to develop total maximum daily load analyses which include monitoring the effectiveness of pollution control activities, and
7. To support development of strategies to return impaired waters to compliance with water quality standards.

Coordination with Other Monitoring Efforts in Missouri

To maximize efficiency, the department routinely coordinates its monitoring activities to avoid overlap with other agencies and provide and receive interagency input on monitoring study design. The department also cooperates with other agencies in performing special water quality studies.

Data from other sources is used for meeting the same objectives as department sponsored monitoring. The agencies most often involved are the U.S. Geological Survey (USGS), the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency (EPA), the Missouri Department of Conservation (MDC), the U.S. Department of Agriculture (USDA)/Agricultural Research Service (ARS) and the Missouri Department of Health. However, the department also tracks the monitoring efforts of the U.S. Park Service, the U.S. Forest Service, several of the state's larger cities, the states of Arkansas, Kansas, Iowa and Illinois and graduate level research conducted at universities within Missouri. The department also uses monitoring data acquired by wastewater dischargers as a condition of discharge permits issued by the department. The department began using data collected by volunteers that have passed Quality Assurance/Quality Control (QA/QC) tests in 1995.

Data from two new sources, the U.S. EPA Regional Environmental Monitoring and Assessment Program (REMAP) and the USGS National Water Quality Assessment Program (NAWQA) will be used as it becomes available.

Networks and Programs

1. Fixed Station Network

   A. Objective: To better characterize background or reference water quality conditions, to better understand daily flow event and seasonal water quality variations and their underlying processes, to assess time trends and to check for compliance with water quality standards.

   B. Design Methodology: Sites were chosen based on one of the following criteria:
      X site is believed to have water quality representative of many neighboring streams of similar size due to similarity in watershed geology, hydrology and land use, and the absence of any impact from a local point or discrete nonpoint water pollution source.
      X site is downstream of a significant point source or localized nonpoint source area.

   C. Number of Sites, Sampling Methods, Sampling Frequency, Parameters:
      X USGS/DNR cooperative network: 35 sites state-wide, horizontal and vertical integrated grab samples, 6-12 times per year; major ions, nutrient ions, temperature, pH, dissolved oxygen, specific conductance, suspended solids, and heavy metals flow 2-4 times annually; and pesticides 6 times annually at 6 sites.
      X Crowder College network: 6 sites in southwest Missouri, grab samples, monthly, pH, conductance, temperature, total phosphorus, ammonia nitrogen, nitrate plus nitrite, nitrogen, fecal coliform and fecal strep bacteria.
      X DNR raw water sampling of public drinking water reservoirs: 4 sites, grab samples, 4 times annually, common herbicides.
      X University of Missouri-Columbia/DNR lake monitoring network, about 100 lakes monitored during the summer and about 12 monitored spring through fall for nutrients, chlorophyll, turbidity and suspended solids.
      X DNR routine monitoring of finished public drinking water supplies for bacteria and trace contaminants.

2. Intensive Surveys

   A. Objective: To characterize the water quality impacts from a specific pollutant source or area.

   B. Design Methodology: Determination of contaminants of concern based on previous water quality studies, effluent sampling and or permit applications, use of multiple sampling stations downstream and upstream (if appropriate). If contaminants of concern have significant seasonal or diel variation, season of the year and time of day variation must be accounted for in sampling design. These studies would also require multiple samples per site over a relatively short time frame (e.g., 6-8 visits over a 2-3 day period or 10-15 visits over a 2-3 year period).

C. Number of Sites, Sampling Methods, Sampling Frequency, Parameters:
Missouri DNR conducts or contracts for 4-6 special studies annually. Each study has multiple sampling sites. Number of sites, sampling frequency and parameters all vary greatly depending on the study.

3. Toxics Monitoring Program

Monitoring of toxics is not a separable part of the monitoring program. The fixed station network and many intensive studies monitor for toxic chemicals. In addition, major municipal and industrial dischargers must monitor for toxicity in their effluents as a condition of their discharge permits (typically referred to as National Pollutant Discharge Elimination System or NPDES permits).

4. Biological Monitoring Program

A. Objective: To develop numeric criteria describing Areference≅ aquatic macroinvertebrate communities in Missouri=s wadeable streams.

B. Design Methodology: Identification of 45 Areference≅ streams divided among Missouri=s three aquatic ecoregions. Intensive sampling of invertebrate communities to quantify temporal and spatial variation in reference streams within ecoregions and variation between ecoregions. This program also includes sampling of chemically and physically impaired streams to test the sensitivity of various community metrics to differences in stream water quality.

C. Number of Sites, Sampling Methods, Sampling Frequency, Parameters:
45 reference sites, 40 other sites with varying degrees of physical or chemical impairment, modified EPA Rapid Bioassessment Protocol for Invertebrates. Sites have been sampled 2-6 times over the last five years for aquatic invertebrates, temperature, dissolved oxygen, specific conductance and nutrient ions.

5. Fish Tissue

A. Objective: Measure levels of bioaccumlative toxicants in fish.

B. Design Methodology: Sites were chosen based on one of the following criteria:
X site is believed to have water and sediment quality representative of many neighboring streams of similar size due to similarity in geology, hydrology and land use, and the absence of any known impact from a local point source or discrete nonpoint water pollution source.
X site is downstream of a significant point source or localized nonpoint source area.

C. Number of Sites, Sampling Methods, Sampling Frequency, Parameters:
15 sites, fish taken by electroshocking, ideally a sample is composed of five whole carp Cyprinis carpio of equal size (fish of approximately 18" length are preferred). Sites are sampled once every two years and are analyzed for several chlorinated hydrocarbon insecticides, PCBs, lead, cadmium, mercury and fat content.

Laboratory Analytical Support

1. Laboratories Used:
   - X USGS/DNR Cooperative Fixed Station Network: USGS Lab, Denver, Colorado
   - X Crowder College Network: Crowder College, Neosho, Missouri
   - X DNR Public Drinking Water Reservoir Network: Missouri DNR Environmental Lab
   - X Intensive Surveys: Varies, many are done by Missouri DNR Environmental Lab
   - X Toxicity Testing of Effluents: many commercial labs
   - X Biological Criteria for Aquatic Invertebrates: Missouri DNR Environmental Lab and University of Missouri, Columbia
   - X Fish Tissue: USEPA Region VII Lab, Kansas City, Kansas and miscellaneous contract labs (Missouri Department of Conservation)
   - X NPDES self-monitoring: Commercial labs
   - X DNR Public Drinking Water Monitoring: Missouri DNR and commercial labs
   - X Agricultural Research Service: ARS lab

2. Issues:

   USGS, Denver, Colorado. (1) For several years the laboratory had used inadequate reagent volumes in Total Phosphorus analysis. The lab has published a paper on the situations where erroneous data was believed to occur. The problem was associated with high levels of phosphorus usually only encountered in certain effluents and should not have caused an error in analysis of phosphorus in Missouri streams. (2) USGS has recommended new Aclean procedures≅ for making accurate measurements of certain heavy metals. Because of the great expense of using these new methods, the USGS/DNR coop network continues to use the old methods. The rationale for this decision was that the old method is still reliable enough to discern any exceedences in water quality standards, but may not be of value in correlating heavy metals to water quality or other environmental variables and probably will not allow time trend analysis on most waters of the state.

   USEPA. The EPA lab reduced Missouri=s allocation of fish tissue analyses when the Missouri Department of Conservation established a large fish tissue monitoring network. The Department of Conservation may eliminate or greatly reduce fish tissue monitoring in response to budgetary problems and the EPA lab will need to increase the number of fish tissue samples it allocates to Missouri.

Quality Assurance/Quality Control Program (QA/QC)

Missouri and Region VII EPA have completed a Total Quality Management Plan. All environmental data generated directly by the department or through contracts funded by the department or EPA will require a quality assurance project plan following the EPA Requirements for quality assurance project plans for environmental data operations (EPA QA/R-5).

Data Storage, Management and Sharing

The department retrieves raw data from the U.S. EPA database, STORET, from the USGS database, WATSTORE, and from numerous state, federal and municipal sources that do not store data in STORET or WATSTORE. This data is imported into the Missouri state computer system for storage and statistical analysis. The department maintains some water chemistry data in mainframe computer files (SPFPC files) at the state computer center in Jefferson City. Data in these files comes from STORET, WATSTORE and other databases from state agencies, large municipalities and public water supply companies. These files are retrieved, manipulated and statistically analyzed using statistical software, typically SAS.

Other special files such as volunteer monitoring data, herbicide data for surface waters and ground waters, data on pesticides in fish tissue, and results of toxicity testing of effluents and receiving waters are maintained in SPFPC or DBASE files within the department=s Water Pollution Control Program. These may include Access databases in the future. Data on permitted waste water treatment facilities state-wide, including results of effluent monitoring and an assessment of the water quality impacts of these facilities, is maintained at the state computer center in the Water Quality Information System (WQIS). Incompatibility of separate files, inability to link files and large amounts of data that have not yet been entered into any electronic file are serious data management problems that remain to be addressed.

The Missouri Department of Conservation is in the process of developing statewide databases for both fish and aquatic macroinvertebrates.

Training and Support of Volunteer Monitoring

Two volunteer monitoring programs are now generating water quality data in Missouri. The first is a cooperative program between the Department of Natural Resources, the University of Missouri and volunteers that monitor approximately 16 lakes, including Lake Taneycomo, Table Rock Lake and several lakes in the Kansas City area. Data from this program is used by the University as part of a long-term study on the limnology of Midwestern reservoirs.

The second program monitors water quality of streams throughout Missouri. It is a cooperative project of the Department of Natural Resources, the Department of Conservation and the Conservation Federation of Missouri. By the end of 1997, this program had provided initial training, equipment and supplies to about 971 volunteers, provided secondary training and quality assurance-quality control ratings for 153 members of this group and established a database for all data reported by the volunteers.

Data Interpretation and Communication

Missouri does not use the EPA Water Body System (WBS) database because of its poor performance. In 1990, Missouri made amendments to its state database, WQIS, which would allow recording all data required by EPA for WBS at that time. The 1996 database in Access software was forwarded to EPA in March 1998 and the 1998 database will be sent to EPA later in 1998 in Access. EPA is now requesting states to submit data electronically in Access and has now abandoned WBS in favor of Access software. The department plans on making annual submissions in Access software thereafter.

In 1997, USEPA committed its contractor to geo-referencing all of Missouri=s classified waters. No schedule has been set for completion of this work.

Water quality data accessibility is easy. Just contact the Water Pollution Control Program for more information as follows:

1. Requests for very general information on water quality. These requests are filled by the 305(b) report, pamphlets or fact sheets. Call 1-800-361-4827.

2. Requests for information on a specific waterbody or for more detailed information on a specific topic that might include summaries of major studies or summary of available data. These requests are usually filled by the Missouri Basin Plans, a document that describes Missouri=s 77 basins and provides information on land use, hydrogeology, stream flow and water quality in each.

3. Requests for published reports or water quality data files. If the report or data was generated by the department, it can be obtained either through the mail (paper copy for small reports and data files or on floppy disc for larger data files) or by visiting the department office at 205 Jefferson Street in Jefferson City and viewing the files directly. If the report or data file did not originate with the department, the request is sent to the organization that published the report/data.

Requests for water quality information or requests to view water quality data files should be sent to:

Missouri Department of Natural Resources
Water Pollution Control Program
ATTN: John Ford
P.O. Box 176
Jefferson City, MO 65102-0176
Phone: (573) 751-7024 Fax: (573) 526-5797
Internet: nrfordj@mail.dnr.state.mo.us

Monitoring Program Evaluation

The water quality monitoring program within the department has traditionally focused on the chemical characterization of water quality in streams both free of and those subject to point source waste water discharges. While the monitoring has been able to keep pace with the more critical point source assessment needs and has done a good job of characterizing regional water quality unimpaired by point source discharges, the size and scope of the department=s monitoring has fallen far short of the state=s information needs.

The response to these additional needs has included these actions:

(1) seeking out and using all other available water quality data judged to be of good quality
(2) increasing, to the degree the budget allows, water quality monitoring activities
(3) shifting some emphasis from chemical to biological monitoring in an effort to increase the number of monitored waters and to improve the effectiveness in assessing certain types of nonpoint water pollution
(4) shifting some emphasis from the fixed station monitoring network to more shorter term intensive studies to meet requirements for conducting total maximum daily load studies.

PLAN FOR ACHIEVING COMPREHENSIVE ASSESSMENTS

Large Rivers

1. Fixed Station Water Quality Monitoring Network: The department plans to maintain 12-15 fixed sites on large rivers that will be monitored 6-12 times annually for a long list of conventional contaminants, major ions, nutrient ions, heavy metals. Some of the stations will also have pesticide monitoring. These sites will be chosen as those most representative of the physiographic province they are in and ones with the largest existing water quality record.

2. Sediment Monitoring Network: Since sediment chemistry tends to be much less variable at a given location over time than water chemistry, a sediment monitoring schedule can be much less frequent than one for monitoring water. The monitoring network includes bulk sediment chemistry, sediment pore water chemistry and pore water toxicity at approximately 5-7 sites annually. Fixed sites, which includes several locations on large rivers will be sampled once every five years.

3. Long-Term Monitoring Program: We will continue doing chemical and biological monitoring on the Mississippi River, and support the present multi-state initiative to create a similar project on the Missouri River.

Discussion: The water and sediment monitoring locations will be chosen so that rivers from all physiographic provinces and predominant land use categories are represented. Thus most unmonitored larger rivers in the state can be Aevaluated≅ based on monitored representative streams from areas of similar geology, hydrology and land use. As land use patterns change,

some unmonitored larger rivers may become unlike nearby monitored ones, (e.g., a basin may receive many large CAFOs while the nearby monitored basin does not). In this case, the river with changing land uses will need to be added to the network.

This situation has already occurred in the Elk River basin, where many large poultry operations are now located. Several years ago, the fixed water quality monitoring station on the Elk at Tiff City was monitored only every second or third year as a station representative of southwestern Missouri. It is now monitored annually, not as a representative stream for rural southwest Missouri, but as a stream draining a basin with a large amount of poultry production.

Wadeable Streams (Small Rivers and Creeks)

1. Visual/Qualitative Aquatic Invertebrate Rapid Stream Assessment: A protocol for rapid stream assessment was developed and implemented by the department in 1982 and has been practiced unchanged since that time. The goal of the rapid stream assessment program is to make an assessment of the impact of all municipal wastewater discharges, limestone quarries, clay pits and landfills at least once every five years and to assess non-municipal wastewater discharges on an as needed basis based on regional office inspection reports.

   At present about 0.15 full-time equivalent staff (FTE) spread among two members of the Division of Environmental Quality, WPCP Planning Section of the department, is dedicated to this work. This meets only about 40% of the monitoring objective. Over the next two years the goal is to recruit and train three additional WPCP staff in this rapid assessment procedure and to increase staff effort to 0.45 FTE, which would translate into about 250 stream evaluations per year.

2. Volunteer Water Quality Monitoring: Data collected by volunteers who successfully complete a quality assurance workshop is entered into the department=s water quality databases and is used by the department in the same way as the visual/qualitative benthic data collected by the department. Some volunteers are doing only chemical monitoring but many are also doing semi-quantitative macroinvertebrate benthic sampling. By the end of 1997, volunteers with acceptable quality assurance ratings were monitoring and reporting to the department on 43 stream sites regularly (on average about twice per year). As the volunteer monitoring program expands, the number of streams monitored by volunteers will increase.

3. Aquatic Macroinvertebrate Monitoring Program: By 2002, the department will have a 150-site macroinvertebrate monitoring network in the state that will be evaluating streams against numeric criteria for invertebrate communities in Missouri=s Water Quality Standards. The present 2.5 FTE within the department's Environmental Services Program that is now developing the criteria will, upon completion of criteria development, initiate the sampling of this network. Based upon present performance, the 2.5 FTE will be sufficient to monitor 50 sites per year, so that all sites will be evaluated once every three years. In any given year it is estimated that 10% of the sites will be from the original group of 45 reference sites used to develop the biocriteria. This is necessary because invertebrate fauna at a given site varies from year to year and since the criteria will be based on a comparison

to reference sites within the same aquatic ecoregion, reference sites within that ecoregion must be sampled at the same time as the non-reference streams. The remaining 90% of sites in a given year will be equally divided between sites specifically selected because of the potential for impact from known point or nonpoint water pollution sources and sites selected randomly (probability based sampling).

4. Intensive Surveys: There is a great variety of water quality monitoring efforts generally referred to as Aintensive surveys.≅ They have in common only the fact that they are efforts that are aimed at answering a specific question on a specific waterbody or group of waterbodies. Examples would include wasteload allocation studies which result in determining acceptable effluent loads from point source discharges; total maximum daily load studies (TMDL) which determine acceptable contaminant loads from the entire watershed; less intensive chemical studies of point or discrete nonpoint source discharges; monitoring in support of Section 319 watershed projects; and a number of other studies relating to effluent quality, surface or ground water quality or hydrology or studies of the aquatic biota. It appears that there is a need to significantly increase monitoring funds to more accurately evaluate streams for compliance with standards and to complete present and near future TMDL study needs.

Lakes

1. Lake Monitoring Network: Approximately 110 Missouri lakes are monitored quarterly for nutrients, chlorophyll and solids by the University of Missouri under a cooperative program with Missouri DNR. This project has been ongoing for several years and has characterized the trophic states of these lakes and has laid the foundation for a basic understanding of the relationship of nutrients, mineral solids and algal productivity in midwestern reservoirs.

2. Lakes of Missouri Volunteer Monitoring Program: This program has recruited over 70 volunteers to collect water samples and make field observations. Eleven reservoirs in Missouri were monitored by this program in 1997.

ASSESSMENT METHODOLOGY

This section describes the procedures used by the Missouri Department of Natural Resources (MDNR) to rate the quality of Missouri=s waters.

Water quality is judged by its conformance with Missouri=s Water Quality Standards. These standards were first implemented for all Missouri streams and a few large lakes in 1970 and are revised every three years. These standards now list 21,978 miles of classified streams and 415 significant public lakes representing 292,204 surface acres of water, and the uses for which these waters are protected. These standards also list the maximum allowable concentrations of chemicals and bacteria in these waters.

The table below lists the various uses of Missouri=s waters and the portions of state waters that

are protected for each use.

TABLE 5. MISSOURI WATERS PROTECTED FOR VARIOUS USES

Use		Stream Miles	% of Total	Lake Acres	% of Total
Protection of Aquatic Life and Fish Consumption		21,975.3	100	292,204	100
Subset:	Warm-Water Fishery	18,990.1	86	281,474	96
	Cool-Water Fishery*	2,756.7	13	0	0
	Cold-Water Fishery**	228.5	1	10,730	4
Livestock and Wildlife Watering		21,975.3	100	292,204	100
Whole-Body-Contact Recreation		5,373.4	25	261,451	89
Boating		6,912.7	33	234,205	80
Drinking Water Supply		3,182.7	15	100,839	35
Industrial		1,588.5	8	7,003	2
Non-degradation: Outstanding National		171.2			
	State Resource Waters	192.5***			
Irrigation		4,035.0			
Total Classified Waters in Missouri		21,975.3		292,204	

* Smallmouth Bass, Rock Bass

** Trout

*** Outstanding State Resource Waters also include 270 acres of wetlands in 3 locations.

Classified waters of Missouri include all permanently flowing streams or streams with permanent pools. All classified waters of the state and all significant public lakes are classified for protection of aquatic life, livestock and wildlife watering and fish consumption by humans. The Water Quality Standards for these uses set the maximum allowable concentrations for 110 chemicals in these waters. A subset of these waters classified for drinking water supply have maximum allowable concentrations for an additional 20 chemicals in the standards. Waters protected for whole-body-contact recreation such as swimming or water skiing also have a maximum allowable bacteria standard.

Missouri=s Water Quality Standards also contain narrative criteria. These standards are not numbers but general statements about DNR=s expectations for waters of the state. These standards require waters to be free of objectionable odors, color, turbidity, floating materials or bottom deposits and to be free of conditions harmful to aquatic life such as high water temperature, low dissolved oxygen or chemical toxicity. Importantly, these standards apply not just to the classified waters, but to all waters of the state including the small intermittent streams that only carry water during and shortly after rain or snow melt.

Table 6 below shows how the chemical and bacterial standards and aquatic biological information are used to rate the quality of Missouri=s waters.

TABLE 6. METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE*	COMPLIANCE WITH WATER QUALITY STANDARDS
Overall use protection	No data--evaluated based on similar land use/ geology as stream with water quality data.		Given same rating as monitored stream with same land use and geology.
	Visual observation of stream and qualitative evaluation of aquatic macroinvertebrates.	1	Full: Stream appearance and aquatic invertebrates typical of reference streams in this region of the state. Partial: Odor, turbidity, objectionable, suspended matter or bottom deposits that would interfere with beneficial uses or reduced diversity of aquatic macroinvertebrates. Non-Attainment: Odor, turbidity, or objectionable suspended matter bottom deposits severe enough to prohibit beneficial use or only pollution tolerant aquatic invertebrates found.
Protection of Aquatic Life	Chemical (toxics)	1-2	Full: No more than 1 exceedence of acute criterion in 3 years; less than 10% of all samples exceed chronic criterion. Partial: More than 1 exceedence of acute criterion in 3 years; less than 10% of all samples exceed chronic criterion. Non-Attainment: More than 10% of all samples exceed chronic criterion.
	Chemical (conventional)	1-2	Full: Less than 10% of all samples exceed criterion. Partial: 10-25% of all samples exceed criterion. Non-Attainment: More than 25% of all samples exceed criterion.
	Biological	3	Full: Fauna very similar to regional reference streams. Partial: Diversity or number of intolerant taxa slightly to moderately less than reference streams. Non-Attainment: Diversity or number of intolerant taxa much less than reference stream.
	Toxicity testing of effluent	2	Full: No statistically significant mortality in either of two tests species at the AEC*** or the AEC must be less than 30% of the LC_{50}** for both test species. Non-Attainment: Conditions for full attainment not met.
	Toxicity testing of streams or lakes	3	Full: No statistically significant deviation from controls in chronic test endpoints in at least two representative species. Non-Attainment: Statistically significant mortality

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE*	COMPLIANCE WITH WATER QUALITY STANDARDS
			in at least one of two representative test species.
Fish Consumption	Chemicals (water) Chemicals (tissue)	1-2	Full: Water quality criteria not exceeded as a long-term average; fish consumption advisories allow typical or average fish consumption rates for all commonly eaten species. Partial: Fish consumption advisories allow less than typical or average consumption rate for at least one commonly eaten species. Non-Attainment: Water quality criteria exceeded as long-term average or consumption banned for at least one commonly eaten species.
Drinking Water Supply	Physical, chemical (nutrients)	1-2	Full: Very little loss of lake volume due to sedimentation, low levels of nutrients, no history of taste or odor problems due to algae. Threatened: Rate of sedimentation moderate and no taste and odor problems known but nutrient or algae levels similar to lakes with taste and odor problems. Partial: Water supply may be inadequate in dry years due to loss of volume to sedimentation or supply has infrequent taste and odor problems. Non-Attainment: Water supply has chronic water shortage due to loss of storage volume to sedimentation or frequent taste and odor problems or supply causes infrequent gastrointestinal problems in users.
	Chemical (toxics, raw water)	1-2	Full: Mean values do not exceed criterion or Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs). Threatened: Chemical use patterns in watershed are similar to watersheds with non-attainment. Non-Attainment: One or more contaminants have mean values in excess of water quality criteria or SDWA MCLs.
	Chemical (Iron, Manganese, Total Dissolved Solids, Raw Water)	1-2	Full: Mean values do not exceed criterion. Threatened: Mean values do not exceed criterion but time trends suggest mean may be exceeded in future. Non-Attainment: Mean values exceed criterion.
	Chemical (toxics, finished water)	1-2	Full: No MCLs or Water Quality Standards criteria exceeded or significant taste and odor problems using only convention treatment (sedimentation-disinfection). Threatened: Chemical use patterns in watershed are similar to watersheds not in full attainment. Partial: Additional treatment needed to meet MCLs or Water Quality Standards criterion. Non-Attainment: At least one contaminant has annual average exceeding MCL or Water Quality Standards criterion or supply has been closed during the past 2 years due to contamination of raw water entering the plant.

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE*	COMPLIANCE WITH WATER QUALITY STANDARDS
			NOTE: water quality problems caused by the drinking water treatment process such as the formation of Trihalomehtanes (THMs) are not included.
Whole-Body-Contact Recreation	Fecal Coliform count	1-2	Full: Water Quality Standards not exceeded as a geometric mean for samples collected during the recreation season and at times not influenced by storm water flows. Non-Attainment: Geometric mean does exceed Water Quality Standard criterion during recreation season at times not influenced by storm water flows.
Irrigation, Livestock and Wildlife Water	Chemical (boron, cobalt)	1-2	Full: Mean value does not exceed water quality criteria. Non-Attainment: Mean value does exceed water quality criteria.

* Data quality codes have been established by EPA to rate the quality and quantity of data from a specific source. Level one data is the lowest level of useable data and includes infrequent chemical monitoring or qualitative biological monitoring. Level Two data would include intensive water chemistry studies, long-term water chemistry monitoring sites and fish tissue analysis. Levels Three and Four are for detailed biological studies of fish, aquatic invertebrates and toxicity testing of waters.

** LC_{50} The concentration of a contaminant that kills 50% of test organisms.

*** AEC = Acceptable Effluent Concentration. This is the percentage of effluent in a solution of effluent at the effluent design (max.) Flow mixed with 2.5% of the $7Q_{10}$ low flow of the receiving stream. This would simulate the instream toxicity potential of the discharge during dry weather.

WATER QUALITY ASSESSMENT

Table 7. Summary of Fully Supporting, Threatened and Impaired Waters

Degree of Use Support	Evaluated Streams Miles	Monitored Streams Miles	Total Stream Miles Assessed	Evaluated Lake Acres	Monitored Lake Acres	Total Lake Acres Assessed
Fully Supporting All Assessed Uses	8,262.2	2,870.0	11,132.2	15,232	116,971	132,203
Full Supporting All Assessed Uses, But Threatened For at Least One Use	89.0	170.7	259.7	11,332	105,484	116,816
Impaired For One or More Uses	6,535.9	3,657.4	10,193.3	525	42,660	43,185
Not Attained For Any Use and Not Included Above	0	0	0	0	0	0
TOTAL ASSESSED	14,887.1	6,698.1	21,585.2	27,089	265,115	292,204

Monitored waters are those where water quality data has been collected in the last 5 years.

Evaluated waters are those which have not been monitored in the last 5 years but have geology and land use similar to nearby monitored waters and whose water quality assessment is assumed to be the same as those nearby monitored waters.

IMPAIRED WATERS AND OTHER AREAS OF CONCERN

CATEGORY 1
RECOMMENDED SECTION 303(d) WATERS REQUIRED TO HAVE TMDLs

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers				
1529 Little Beaver Creek	Phelps	0.1	NFR	Rolla SW WWTP
1746 Big Bottom Creek	Ste. Genevieve	0.5	BOD, NFR	Lake Forest Subdivision
2916 Big Creek	Iron	4	Metals	Doe Run Lead smelter
1224 Big Otter Creek	Henry/St. Clair	1	pH	Otter Creek AML
2074 Big River	Jefferson	53	Lead	Old Lead Belt AML
2080 Big River	St. Francis	40	Lead, sediment	Old Lead Belt AML
2755 W. Fk. Black River	Reynolds	0.2	Nutrients	Doe Run W. Fork Mine
0811 E. Brush Creek	Moniteau	1	Nutrients	California N. WWTP
1370 Brush Creek	St. Clair	1	Inundation	Truman Dam
1592 Brushy Creek	Texas	0.2	NFR	Houston WWTP
0859 Brushy Fork	Pettis	1	BOD, NFR, NH_3N	Sedalia Central WWTP
3269, 3273 Buffalo Creek	McDonald	15.5	Nutrients	Livestock production
3118 Buffalo Ditch	Dunklin	2	BOD	Kennett WWTP
0709 Bynum Creek	Callaway	0.3	Sediment	Auxvasse Stone Quarry
9000 Cave Spring Branch	McDonald	0.2	Nutrients	Livestock/Simmons
0737 Cedar Creek	Callaway	2	pH, sulfate	Cedar Creek AML
		1	Sulfate	Cedar Creek AML
		1	Sulfate	Manacle, Cross-Mitchell AMLs
3203 Center Creek	Jasper	11	Zinc	Tristate AML
0640 Chariton River	Chariton	29	Fecal coliform	Unknown
3168 Chat Creek	Lawrence	2	Zinc	Aurora AML
3238 Clear Creek	Newton	1	BOD, NFR, NH_3N	Monett WWTP
3239 Clear Creek	Barry/Lawrence	2	BOD, NFR, NH_3N	Monett WWTP
0690 Dark Creek	Randolph	8	Sulfate	Crutchfield AML
0912 Davis Creek	Lafayette	2	BOD, Nutrients	Odessa SE WWTP
0510 Dog Creek	Daviess	0.2	Sediment	Traeger Quarry
1145 Dry Auglaize Creek	Laclede	1.5	BOD, NFR	Lebanon WWTP
2604 Eleven Point River	Howell	0.4	Chlorine	Willow Springs WWTP
3246 Elk River	McDonald	21.5	Nutrients	Livestock production
2168 Flat River Creek	St. Francis	5	Lead, sediment, zinc	Old Lead Belt AML
2860 Goose Creek	Madison	0.5	Nickel	Madison mine outflow
0883 Gabriel Creek	Morgan	1.1	BOD, NFR	Stover NW WWTP, Stover SW WWTP
1007 Hinkson Creek	Boone	6	Unspecified	Urban nonpoint source
1008 Hinkson Creek	Boone	5	Unspecified	Urban nonpoint source
1251 Honey Creek	Henry	3	Sulfate	Reliant AML
2582 Howell Creek	Howell	0.3	Chlorine	West Plains WWTP
3256 Indian Creek	McDonald/Newton	26	Nutrients	Livestock production
3262, 3263 M. Indian Cr.	Newton	5.5	Nutrients	Livestock production
3260 N. Indian Creek	Newton	5	Nutrients	Livestock production

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers (cont.)				
3259 S. Indian Creek	Newton	9	Nutrients	Livestock production
2681 Jacks Fork River	Shannon	5	Fecal coliform	Organic wastes
2347, 2362, 2365 James River	Greene/ Stone/Christian	58.5	Nutrients, unknown	Urban point & nonpoint source
1016 Kelley Branch	Boone	1	Habitat loss	ORV use Finger Lakes State Park
1438 Little Lindley Creek	Dallas	1	BOD, NFR	Buffalo WWTP
0427 E. Fk. Little Blue R.	Jackson	0.1	BOD, NFR	Independence MHP
0535 Long Creek	Caldwell	0.2	Sediment	Everett #6 Quarry
2814 Main Ditch	Butler	5	BOD, NFR	Poplar Bluff WWTP
0742 Manacle Creek	Callaway	2	pH, sulfate	Manacle Creek AML
1308 Marmaton River	Vernon	49.5	Not stated	Natural background
2787 McKenzie Creek	Wayne	0.5	pH	Gads Hill Quarry
1234 Monegaw Creek	St. Clair	3	Sulfate	Montee AML
0942 N. Moreau Creek	Moniteau	10	Susp. Algae	California S. WWTP
1300 Mound Branch	Bates	1	BOD	Butler WWTP
0856 L. Muddy Creek	Pettis	0.7	Temperature	Tyson's Foods Inc.
0855 Muddy Creek	Pettis	33	BOD	Sedalia Central WWTP
3490 Trib. L. Muddy Creek	Pettis	0.4	Temperature, NH_3N	Tyson's Foods Inc.
1305 Mulberry Creek	Bates	8	Sulfate	Mulberry Creek AML
3652 Little Osage River	Vernon	16	Not stated	Natural background
1310 Little Osage River	Vernon	6.3	Not stated	Natural background
1031 Osage River	Miller/Cole	0.4	Habitat loss	Capital Sand & Gravel, Osage Sand & Gravel
3268 Patterson Creek	McDonald	2	Nutrients	Livestock production
2373 Pearson Creek	Greene	1.5	Unknown toxicity	Unknown
2614 Piney Creek	Oregon	0.1	Chlorine	Alton WWTP
1714 Rock Creek	Jefferson	2	BOD, NH_3N	2 WWTPs
1014 Rocky Fork	Boone	0.5	Sediment	Finger Lakes AML
0278 Rush Cr.	Platte	0.2	BOD, NFR	Platte Co. Sewer District #7 WWTP
1381 L. Sac River	Greene/Polk	27	Fecal coliform	Springfield NW WWTP
2859 Saline Creek	Madison	0.5	Nickel	Madison mine outflow
2190 Saline Creek	Jefferson	2	BOD, NH_3N	Ron Rog WWTP, Hwy 141 WWTP
0091 Salt River	Ralls	29	Manganese,Iron,Low D.O.	Cannon Dam
0103 Salt River	Ralls/Pike	10	Low D.O., Manganese	Cannon Dam
1319 Second Nicholson Creek	Barton	3	Sulfate	Many AML areas
2170 Shaw Branch	St. Francis	2	Sediment	Federal AML
2120 Shibboleth Creek	Washington	0.5	Sediment	Barite tailings pond
3230 Shoal Creek	Barry/Newton	13.5	Fecal coliform	Unknown ag. sources
0400 W. Fk. Sni-a-Bar Cr.	Jackson	0.2	BOD, NFR	Lake Lotawana WWTP
2835 St. Francis River	St. Francis	3	NH_3N, BOD	Farmington W. WWTP
1361 Stockton Branch	Cedar	2	Susp. Algae	Stockton WWTP
0959 Straight Fork	Morgan	2	Susp. Algae	Versailles WWTP
3250 B. Sugar Creek	McDonald/Barry	31	Nutrients	Livestock production
3249 L. Sugar Creek	McDonald	11	Nutrients	Livestock production

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers (cont.)				
0686 Sugar Creek	Randolph	1	pH	Huntsville AML
		0.5	pH	Calfee Mine Flow
1282 E. Fk. Tebo Creek	Henry	1	pH	Triple Tipple AML
1284 M. Fk. Tebo Creek	Henry	5.5	Sulfate	Newcastle Tipple AML, other AML
1288 M. Fk. Tebo Creek	Henry	2	pH, sulfate	Newcastle Tipple AML
		1.5	Sulfate	Newcastle Tipple AML
1292 W. Fk. Tebo Creek	Henry	7	Sulfate	Spargler AML
2850 Trace Creek	Madison	4.2	pH	Unknown
		1.3	pH	Unknown, sawdust pile leachate
1211 Trib. Barker□s Creek	Henry	0.3	pH, sulfate	Grey AML
1225 Trib. Big Otter Creek	Henry/St. Clair	1	pH	Otter Creek AML
2128 Trib. Pond Creek	Washington	0.5	Sediment	Barite tailings pond
3217 Turkey Creek	Jasper	5	Zinc	Duenweg AML
3216 Turkey Creek	Jasper	3.5	Zinc	Duenweg AML
		4	PCP	Joplin Turkey Crk WWTP
		4	BOD, NFR	Joplin Turkey Crk WWTP
3282 Turkey Creek	St. Francis	1.5	BOD, NFR	Bonne Terre WWTP
2864 Village Creek	Madison	0.5	Sediment	Mine la Motte AML
1505 Whetstone Creek	Wright	2	BOD	2 Mountain Grove WWTPs
2375 Wilson Creek	Greene/Christian	18	Unknown toxicity	Urban nonpoint source
Lakes				
7119 Cameron Lower Lake	DeKalb	96	Atrazine	Corn, sorghum production
7120 Cameron Lake #1	DeKalb	25	Atrazine	Corn, sorghum production
7121 Cameron Lake #2	DeKalb	35	Atrazine	Corn, sorghum production
7237 Fellows Lake	Greene	820	Nutrients	Ag/suburban nonpoint source
7124 Hamilton Lake	Caldwell	80	Cyanazine	Corn, sorghum production
7190 Higginsville S. Lake	Lafayette	223	Atrazine	Corn, sorghum production
7022 LaBelle Lake #1	Lewis	17	Atrazine	Corn, sorghum production
7023 LaBelle Lake #2	Lewis	112	Atrazine	Corn, sorghum production
7205 Lake of the Ozarks	Benton	50	Low D.O.	Truman Dam
			Gas supersaturation	Truman Dam
			Fish trauma	Truman Dam
7314 Lake Taneycomo	Taney	1,730	Low D.O.	Table Rock Dam
7356 Lamar Lake	Barton	180	Nutrients	Ag nonpoint source
7033 Mark Twain Lake	Ralls	18,600	Atrazine	Corn, sorghum production
7236 McDaniel Lake	Greene	300	Nutrients	Ag/suburban nonpoint source
7031 Monroe City Route J Lake	Ralls	94	Atrazine	Corn, sorghum production
			Cyanazine	Corn, sorghum production
7187 Spring Fork Lake	Pettis	178	Algae	Ag nonpoint source
7077 Smithville Lake	Clay	7,190	Atrazine	Corn, sorghum production
7207 HS Truman Lake	Bates/Benton	55,600	Manganese	Natural
7032 Vandalia Lake	Pike	37	Atrazine	Corn, sorghum production

CATEGORY 2
RECOMMENDED SECTION 303(d) WATERS REQUIRED TO HAVE ADDITIONAL MONITORING PRIOR TO TMDL DEVELOPMENT

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers				
1250 Big Cr.	Cass/Henry	49	Sediment*	Ag nonpoint source
0449 W. Fk. Big Cr.	Harrison	18	Sediment	Ag nonpoint source
0436 Big Muddy Cr.	Daviess	8	Sediment *+	Ag nonpoint source
0653 Blackbird Cr.	Putnam/Adair	10.5	Sediment+	Ag nonpoint source
0921 S. Fk. Blackwater	Johnson	5	Sediment*	Ag nonpoint source
1336 Clear Cr.	Vernon	18	Sediment+	Ag nonpoint source
0372 E. Fk. Crooked Cr.	Ray	14	Sediment	Ag nonpoint source
1325 L. Drywood Cr.	Vernon	17	Sediment	Ag nonpoint source
0189 Elkhorn Cr.	Montgomery	0.5	Sediment	Ag nonpoint source
0056 N. Fabius R.	Marion/Schuyler	82	Sediment	Ag nonpoint source
0865 Flat Cr.	Pettis	20	Sediment+	Ag nonpoint source
0457 E. Fk. Grand R.	Worth/Gentry	25	Sediment	Ag nonpoint source
0468 M. Fk. Grand R.	Worth/Gentry	25	Sediment+	Ag nonpoint source
0502 Grindstone Cr.	Clinton/DeKalb	16	Sediment	Ag nonpoint source
0337 Honey Cr.	Nodaway	8.5	Sediment	Ag nonpoint source
0554 Honey Cr.	Livingston	23	Sediment	Ag nonpoint source
0212 Indian Camp Cr.	Warren	5	Sediment	Ag nonpoint source
0875 Lake Cr.	Pettis	15	Sediment	Ag nonpoint source
3105 Lat.#2 Main Ditch	Stoddard	11.5	Sediment *	Ag nonpoint source
0606 Locust Cr.	Putnam/Chariton	84	Sediment	Ag nonpoint source
0612 W. Fk. Locust Cr.	Sullivan/Linn	17	Sediment+	Ag nonpoint source
0339 Long Branch	Nodaway	6	Sediment	Ag nonpoint source
0508 Marrowbone Cr.	Daviess	11	Sediment	Ag nonpoint source
0619 E. Fk. Medicine Cr.	Putnam/Grundy	36	Sediment *+	Ag nonpoint source
0623 L. Medicine Cr.	Mercer/Grundy	40	Sediment *+	Ag nonpoint source
1299 Miami Cr.	Bates	18	Sediment	Ag nonpoint source
0159 Mill Creek	Lincoln	4	Sediment	Ag nonpoint source
0001 Mississippi River	Clark-St. Charles	165	Habitat loss	Channelization
1707 Mississippi River	St. Charles-Mississippi	200.5	Habitat loss	Channelization
3152 Mississippi River	Mississippi-Pemiscot	124.5	Habitat loss	Channelization
0226 Missouri River	Atchison-Jackson	179	Habitat loss	Channelization
0356 Missouri River	Jackson-Chariton	125	Habitat loss	Channelization
0701 Missouri River	Chariton-Gasconade	129	Habitat loss	Channelization
1604 Missouri River	Gasconade-St. Charles	100	Habitat loss	Channelization
0345 White Cloud Cr.	Andrew/Nodaway	11	Sediment	Ag nonpoint source
0674 Mussel Fork	Sullivan/Macon	29	Sediment+	Ag nonpoint source
1175 W. Fk. Niangua R.	Webster	0.5	BOD,NFR	Marshfield WWTP
0081 North R.	Marion/Shelby	40	Sediment	Ag nonpoint source
3041 Old Ch. Little R.	New Madrid	20	Sediment *	Ag nonpoint source
		3.5	Sediment	Ag nonpoint source
1444 Piper Cr.	Polk	0.5	NFR	Bolivar WWTP
0327 3rd Fk. Platte R.	Gentry/Buchanan	31.5	Sediment	Ag nonpoint source
0121 M. Fk. Salt R.	Monroe/Macon	49	Sediment	Ag nonpoint source
3134 Spillway Ditch	Mississippi/New Madrid	13.5	Sediment*	Ag nonpoint source
0657 Spring Cr.	Sullivan/Adair	18	Sediment+	Ag nonpoint source
1870 Spring Cr.	Dent	0.3	BOD, NFR	Salem WWTP

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers (cont.)				
3188 N. Fk. Spring R.	Dade/Jasper	51.5	Sediment	Ag nonpoint source
0710 Stinson Cr.	Callaway	0.5	BOD, NH_3N, NFR	Fulton WWTP
0248 L. Tarkio Cr.	Holt	17.5	Sediment+	Ag nonpoint source
0073 Troublesome Cr.	Marion	3.5	Sediment+	Ag nonpoint source
1339 Walnut Cr.	Cedar	1.0	BOD,NFR	El Dorado Spgs. WWTP
0050 S. Wyaconda R.	Clark/Scotland	9.0	Sediment+	Ag nonpoint source
Lakes				
7171 Long Branch Lake	Macon	2430	Cyanazine	Corn, sorghum production
7009 Wyaconda Lake	Clark	8	Atrazine	Corn, sorghum production

* stream has significant amounts of channelization
+ large Concentrated Animal Feeding Operations in this watershed

CATEGORY 3
RECOMMENDED SECTION 303(d) WATERS REQUIRED TO HAVE USE ATTAINABILITY ANALYSES OR TMDL DEVELOPMENT

Water	County	Miles/Acres Affected***	Pollutant	Source
Streams/Rivers				
0417 Blue River	Jackson	4	Chlordane	Urban nonpoint sources
0418 Blue River	Jackson	9	Chlordane	Urban nonpoint sources
0419 Blue River	Jackson	9	Chlordane	Urban nonpoint sources
0421 Blue River	Jackson	2	Chlordane	Urban nonpoint sources
0037 Fox River	Clark	12	Sediment	Ag nonpoint source
0046 Wyaconda River	Lewis	8	Manganese	Natural
0063 M. Fabius River	Lewis	57	Manganese	Natural
Lakes				
7255 Creve Coeur Lake	St. Louis	300	Chlordane	Urban nonpoint source
7054 Lake St. Louis	St. Charles	525	Chlordane	Urban nonpoint source
7211 Pleasant Hill Lake	Cass	115	Chlordane	Unknown
7207 Truman Lake	Bates-Benton	55,600	Manganese	Natural

Notes:

*** Units are in miles for streams and surface acres for lakes.

Abbreviations:

AML	Abandoned mined land	NH_3N	Ammonia
BOD	Biological oxygen demand	pH	Acidic conditions
D.O.	Dissolved oxygen	PCP	Pentachlorophenol
NFR	Non-filterable residue	WWTP	Wastewater treatment plant

ADDITIONAL INFORMATION ON MISSOURI LAKES

Summary Statistics

Information on beneficial use attainment in significant public lakes is given in Tables 1 and 1A. The acreage of these lakes not fully supporting beneficial uses by major source category are as follows:

Point Sources	0 acres
Nonpoint Sources	28,860 acres
Reservoir Releases	11,780 acres

Background

Missouri=s definition of "significant" lakes corresponds to the Department of Natural Resources list of classified lakes and includes any lake that falls into one of the following three categories: (1) small public drinking water reservoirs; (2) large multi-purpose reservoirs; and (3) reservoirs or lakes with important recreational values.

It should be noted that Missouri has only a few naturally occurring lakes, most being depressions or old ox-bows on the Missouri or Mississippi river floodplain. Most "significant" lakes in the state are man-made reservoirs.

Trophic Status

Eutrophication is a natural process that occurs in lakes involving the gradual filling of the lake over time accompanied by increasing aquatic plant growth. This concept also explains the enrichment of lakes and reservoirs by additions of nitrogen and phosphorus from human activity. This additional nutrient load causes increased aquatic plant growth, predominantly phytoplankton, which causes lake water to become greener and more turbid. Trophic state is an important way to characterize lakes because it relates directly to such factors as lake clarity, better in oligotrophic and mesotrophic lakes, and fish production, better in eutrophic lakes.

The trophic status of lakes typically refers to the amount of nitrogen and phosphorus entering the lake or the amount of algae or other aquatic plants present in the lake. Oligotrophic lakes are clear with few nutrients and very little aquatic plant growth. Mesotrophic, eutrophic and hypereutrophic refer respectively to lakes with increasing levels of nutrients and aquatic plant growth.

Lake studies conducted by the University of Missouri between 1989 and 1996 on trophic status of Missouri lakes follows.

TABLE 8. TROPHIC STATUS OF SELECTED MISSOURI RESERVOIRS

LAKE	COUNTY	LOCATION	SECCHI	TP[1]	Ch1-a[2]	TROPHIC[3] STATE	TN[4]
GLACIAL PLAINS							
*Allaman Lake	Clinton	24, 56N, 30W	1.2	42	16	E	683
Baring C-Club Lake	Knox	26, 63N, 12W	1.3	29	23	E	984
Bean Lake	Platte	12-14,54N,37W	0.1	264	144	HE	1,658
Bethany Lake	Harrison	27, 64N, 28W	1.2	38	12	E	764
Big Lake	Holt	18-19,61N,39W	0.2	328	166	HE	2,508
Blind Pony Lake	Saline	SE18,49N,22W	0.7	85	37	E	1,163
Bowling Green Lake	Pike	29, 53N, 2W	1.7	32	11	E	578
Brookfield Lake	Linn	33, 58N, 19W	1.2	26	10	M	663
Concordia Lake	Lafayette	20, 48N, 24W	0.6	87	24	E	1,098
D.C. Rogers Lake	Howard	3, 50N, 16W	1.3	31	7	M	536
Dean Lake			0.1	382	5	HE	2,110
Deer Ridge Lake	Lewis	18, 62N, 8W	0.7	53	18	E	825
Edina Reservoir	Knox	12, 62N, 12W	0.7	71	21	E	1,222
Ella Ewing Lake	Lewis	21, 64N, 10W	0.6	87	28	E	1,410
Fayette Lake #2	Howard	4, 50N, 16W	1.0	52	25	E	906
Forest Lake	Adair	14, 62N, 16W	1.3	27	6	M	441
Green City Lake	Sullivan	NE16,63N,18W	0.7	100	35	E	1,114
Hamilton Lake	Caldwell	15, 57N, 28W	0.8	66	14	E	1,002
Hazel Creek Lake	Adair	31, 64N, 15W	1.5	28	8	M	625
Henry Sever Lake	Knox	14, 60N, 10W	1.0	45	23	E	845
Hunnewell Lake	Shelby	25, 57N, 9W	0.8	51	23	E	835
King Lake	Gentry	SW34,61N,32W	0.2	280	11	E	1,587
Kings Lake	Lincoln	25, 50N, 2E	0.3	278	80	HE	1,573
Lake Contrary	Buchanan	26, 57N, 36W	0.3	365	194	HE	3,060
Lake Mahoney (Unionville)	Putnam	27, 66N, 19W	0.6	107	40	E	1,257
Lake Marie	Mercer	36, 66N, 24W	2.8	15	4	M	449
Lake Paho	Mercer	25, 65N, 25W	0.8	47	14	E	878
Lake Viking	Davies	9, 59N, 28W	1.3	30	11	E	566
Little Dixie Lake	Callaway	26, 48N, 11W	0.6	70	17	E	823
Long Branch Lake	Macon	18, 57N, 14W	0.7	52	14	E	813
Macon Lake	Macon	17, 57N, 14W	0.8	54	23	E	851
Marceline Res.	Linn	28, 57N, 18W	0.6	122	52	E	1,198
Mark Twain Res. (Lower)	Ralls	26, 55N, 7W	1.5	66	13	E	1,221
Mark Twain Res. (Upper)	Monroe			101	16	E	1,220
Maysville Lake (NW)	Dekalb	33, 59N, 31W	0.6	214	44	E	1,301
Memphis Lake #2	Scotland	15, 65N, 12W	0.7	70	37	E	1,196
Mercer Lake	Mercer	30, 66N, 23W		12	2	M	
Milan Lake (New)	Sullivan	35, 63N, 20W	1.0	43	14	E	689
Monroe City Lake B	Monroe	30, 56N, 7W	0.5	85	31	E	1,087
Nehai Tonkayea Lake	Chariton	11, 55N, 18W	1.6	20	3	M	439
Pony Express Lake	Dekalb	33, 58N, 31W	0.8	70	31	E	1,070
Prairie Slough (Oxbow)			0.2	231	72	HE	2,495
Rocky Fork Lake	Boone	31, 50N, 12W	1.9	23	7	M	546
Shelbina Lake	Shelby	20, 57N, 10W	0.6	99	34	E	1,053
Smithville Lake	Clay	13, 53N, 33W	1.1	36	16	E	780
Spring Lake	Adair	SW20,61N,16W	1.3	32	8	M	533
Sterling Price Lake	Chariton	17, 53N, 17W	0.6	108	83	HE	1,545
Sugar Creek Lake (MOB)	Randolph	16, 54N, 14W	0.8	58	27	E	789
Sugar Lake	Buchanan	27, 55N, 37W	0.2	333	173	HE	2,524

LAKE	COUNTY	LOCATION	SECCHI	TP[1]	Ch1-a[2]	TROPHIC[3] STATE	TN[4]
Swan Pond			0.3	345	126	HE	1,658
Thomas Hill Res.	Randolph	24, 55N, 16W	0.7	50	16	E	800
Thunderhead Lake	Putnam	15, 66N, 19W	0.7	53	14	E	962
*Tri-City Comm Lake	Boone	24, 51N, 12W	0.7	57	19	E	874
Vandalia Lake	Pike	12, 53N, 5W	1.2	60	31	E	859
Wakonda Lake	Lewis	NE13, 60N, 6W	0.8	95	51	E	1,186
Watkins Mill Lake	Clay	22, 53N, 30W	0.9	46	17	E	646
Waukomis Lake	Platte	17, 51N, 33W	1.7	25	14	E	590
Williams Lake (Rcky Holl)	Clay	33, 53N, 30W	1.4	55	21	M	784
OSAGE PLAINS							
Amarugia Highlands Lake	Cass	10, 43N, 32W	0.8	62	15	E	794
Atkinson Lake	St. Clair	6, 37N, 28W	0.6	82	34	E	941
Blue Springs Lake	Jackson	3, 48N, 31W	1.0	36	16	E	553
Bushwacker Lake	Vernon	27, 34N, 32W	1.7	28	17	E	605
Cat Claw Lake	Jackson	14, 47N, 31W	0.2	127	4	E	863
Cottontail Lake	Jackson	14, 47N, 31W	0.2	140	15	E	946
Four Rivers CA	Bates	,T38N, R30W	1.0	34	7	M	460
Gopher Lake	Jackson	23, 47N, 31W	0.4	94	17	E	777
Harmony Mission Lake	Bates	15, 38N, 32W	1.7	49	16	E	744
Harrisonville Lake	Cass	26, 46N, 31W	0.9	50	16	E	946
Higginsville Lake	Lafayette	9, 49N, 25W	0.7	119	19	E	1,245
Holden City Lake	Johnson	7, 45N, 27W	0.9	47	14	E	1,078
H.S. Truman Lake	Benton	7, 40N, 23W	1.2	46	15	E	977
Jackrabbit Lake	Jackson	15, 47N, 31W	0.2	168	15	E	783
Lake Jacomo	Jackson	11, 48N, 31W	1.3	34	19	E	573
Lake Tapawingo	Jackson	34, 49N, 31W	1.3	34	33	E	842
Lamar Lake	Barton	32, 32N, 30W	0.8	78	42	E	945
Longview Lake	Jackson	20, 47N, 32W	0.8	38	12	E	757
Lotawana Lake	Jackson	29, 48N, 30W	1.4	31	16	E	672
Montrose Lake	Henry	33, 41N, 27W	0.2	189	63	HE	1,292
Nell Lake	Jackson	15, 47N, 31W	0.6	68	11	E	834
North Lake	Cass	28, 45N, 31W	0.8	87	28	E	928
Prairie Lee Lake	Jackson	27, 48N, 31W	0.8	55	25	E	915
Raintree Lake	Cass	6, 46N, 31W	0.7	59	19	E	1,015
Spring Fork Lake	Pettis	21, 44N, 21W	0.6	136	43	E	1,132
*Tebo Lake (Westmoreland)	Pettis	12, 44N, 22W	2.8	18	4	M	609
Winnebago Lake	Cass	9, 46N, 31W	0.8	55	17	E	886
OZARK BORDER							
Binder Lake	Cole	36, 45N, 13W	1.2	48	15	E	709
Creve Couer Lake	St Louis	20, 46N, 5E	0.3	154	57	HE	1,053
Glover Spring Lake	Callaway	13, 47N, 9W	1.2	67	22	E	863
Indian Hills Lake	Crawford	23, 39N, W	1.0	37	18	E	651
Kraut Run Lake (Busch WA #33)	St. Charles	23, 46N, 2E	0.6	97	52	E	1,070
Lake Ann			1.4	43	22	E	660
Lake of the Ozarks (Lower)	Miller	19, 40N, 15W	1.8	30	15	E	625

LAKE	COUNTY	LOCATION	SECCHI	TP[1]	Ch1-a[2]	TROPHIC[3] STATE	TN[4]
Lake of the Ozarks(Mid)	Camden			44	16	E	618
Lake Northwoods	Gasconade	33, 43N, w	1.0	27	5	M	473
Lake St. Louis	St. Charles	SW26, 47N, 2E	0.5	85	22	E	1,163
Lake Tishomingo	Jefferson	5, 41N, 4E	1.8	24	6	M	489
Lake Wauwanoka	Jefferson	1, 40N, 4E	2.7	14	3	M	677
Lincoln Lake	Lincoln	8, 49N, 1E	2.1	21	6	M	497
Little Prairie Lake	Phelps	21, 38N, 7W	0.8	34	9	M	547
Pinnacle Lake	Montgomery	24, 47N, w	2.6	24	5	M	463
Pleasant Valley	Gasconade	25, 42N, 6W	1.3	39	32	E	895
Pomme de Terre Lake	Hickory	2, 36N, 22W	1.7	31	15	E	569
Stockton Lake	Cedar	15, 34N, 26W	2.6	15	7	M	419
OZARK HIGHLANDS							
Austin Lake	Texas	30, 29N, 11W	1.7	21	7	M	503
*Bella Vista Lake	Cape Girardeau	15, 32N, 13E	1.4	23	12	M	553
*Boutin Lake	Cape Girardeau	15, 32N, 14E	1.5	23	8	M	558
Bull Shoals Lake	Taney	22N, 20W	2.0	19	8	M	355
Clearwater Lake	Reynolds	6, 28N, 3E	1.8	15	5	M	244
Council Bluff Lake	Iron	23, 35N, 1E	3.1	9	3	O	257
Crane Lake	Iron	33, 32N, 4E	1.1	16	3	M	249
Fellows Lake	Greene	22, 30N, 21W	2.5	16	6	M	344
Fourche Lake	Ripley	22, 23N, 1W	3.7	10	3	O	238
Fredericktown City (Lake)	Madison	6, 33N, 7E	0.7	65	33	E	752
Goose Creek Lake	St. Francois	26, 38N, 6E	1.8	16	5	M	407
*Lake Capri	St. Francois	30, 37N, 4E	4.4	8	2	O	299
*Lake Carmel	St. Francois	18, 37N, 4E	2.9	10	3	O	320
Lake Forest,(Lake Ann)	St. Genevieve	36, 38N, 7E	1.4	38	18	E	649
Lake Girardeau	Cape Girardeau	9, 30N, 11E	0.7	73	50	E	1,011
Lake Killarney	Iron	1, 33N, 4E	0.8	68	32	E	655
*Lake Marseilles	St. Francois	29, 37N, 4E	3.7	11	2	O	351
*Lake Pinewoods	Carter	7, 26N, 3E	1.3	45	26	E	858
Lake Springfield	Greene	20, 61N, 16W	1.0	60	19	E	1,016
Lake Taneycomo	Taney	8, 23N, 20W	3.5	23	3	M	803
Lake Turner (Ziske)	Dent	17, 34N, 07W		20	18	E	
Lake Wapapello	Wayne	3, 26N, 3E	1.1	34	18	E	475
Loggers Lake	Dent	10, 31N, 3W	3.1	10	4	M	237
Lower Taum Sauk	Reynolds	33, 33N, 2E	2.1	13	4	M	201
*Macs Lake	Dent		1.4	25	23	E	623
McDaniel Lake	Greene	26, 30N, 22W	1.7	36	17	E	502
*Miller Lake	Carter	1, 27N, 1E	1.5	19	7	M	469
Monsanto Lake (St. Joe State Park)	St. Francois	20, 36N, 5E	2.4	10	2	O	374
Noblett Lake	Douglas	25, 26N, 11W	2.6	18	5	M	255
Norfork Lake	Ozark	21N, 12W	1.7	23	6	M	631
Perry Co. Lake	Perry	22, 35N, 10E	0.7	71	44	E	1,080
Pomona Lake	Howell	26, 26N, 9W		50	10	E	605
Ripley Co. Lake	Ripley	10, 23N, 1E	1.5	32	26	E	787
Roby Lake	Texas	3, 32N, 11W	2.1	18	5	M	431
*Shane Lake	Dent		2.9	8	1	O	324

LAKE	COUNTY	LOCATION	SECCHI	TP[1]	Ch1-a[2]	TROPHIC[3] STATE	TN[4]
*Shawnee Lake	Dent		1.7	30	25	E	610
Sims Valley Lake	Texas	17, 27N, 8W	1.0	26	12	M	478
Sunnen Lake	Washington	4, 37N, 1E	2.7	13	3	M	280
Table Rock Lake	Stone	22, 22N, 22W	3.1	12	6	M	408
Timberline Lake	St. Francois	23, 38N, 04E	3.8	10	2	O	312
Wanda Lee Lake	St. Genevieve	2, 37N, 76	1.4	56	25	E	562
SOUTHEASTERN LOWLANDS							
Tywappity Lake	Scott	8, 29N, 13E	0.9	51	36	E	1,005

[1]Total Phosphorus (UG/L) Secchi depth in meters
[2]Chlorophyll A (MG/Cubic Meter)
[3]Trophic State: O=Oligotrophic, M=Mesotrophic, E=Eutrophic, HE=Hypereutrophic
[4]Total Nitrogen (UG/L)
*Unclassified Lake

Trophic status correlates strongly with physiographic region of the state. In agricultural northern and western Missouri, most lakes of known trophic state are eutrophic, while in the Ozarks and ozark border regions, trophic state is equally divided between eutrophic and either mesotrophic or oligotrophic lakes.

All known hypereutrophic lakes are in glaciated northern Missouri, while all oligotrophic lakes are in unglaciated, highly weathered Ozark terrain.

The method presently used by the state to determine trophic status was derived from the work by Wetzel, R.G., 1975; "Limnology," Table 14-11; and from Vollenweider, R.A. and J.J. Kerekes, 1980. EPA440/5-81-010; "Restoration of Lakes and Inland Waters." The criteria are shown in the table below.

TABLE 9. DEFINITION OF TROPHIC CLASSIFICATION

Trophic Class	Chlorophyll-A (ug/l)	Total phosphorus (ug/l)
Oligotrophic	<3	<10
Mesotrophic	3-10	10-30
Eutrophic	11-56	31-100
Hypereutrophic	>56	>100

STATUS OF WETLANDS

Originally about 4.8 million acres (10.7 percent of the land surface of the state) in Missouri were wetlands. By 1980 this figure had been reduced to about 643,000 acres. Several state and federal programs have recognized the need to preserve and enhance our remaining wetlands.

The Missouri Department of Conservation between 1989 and 1997 has purchased 25,000 acres of wetlands and developed new wetland areas on an additional 16,000 acres.

The U.S. Fish and Wildlife Service has begun acquiring land from willing sellers in the Missouri River floodplain for a new national wildlife refuge called Big Muddy. The project authorizes the purchase of up to 16,000 acres in 7 locations. Presently, the refuge has purchased 6,000 acres at six locations along the river, all but 450 of which are Missouri River floodplain lands that will be allowed to interact naturally with the river and act as seasonal wetlands.

The USDA Wetlands Reserve Program, which began in 1992, purchases easements of wetlands and provides funds for restoration of those wetlands. There are presently 63,000 acres in this program in Missouri, much of which is along the Missouri and Grand rivers. The NRCS, under its Conservation Reserve Program, has an approved practice for wetland restoration, but to date this practice has been used on only a few hundred acres.

CHAPTER 4. GROUND WATER ASSESSMENT

BACKGROUND

Somewhat less than half of the people in Missouri rely on ground water as the source of their drinking water. Ground water is the major source of drinking water in the Ozarks and the Southeast Lowlands for both public and private supplies. The cities of Independence, Columbia and St. Charles use ground water adjacent to the Missouri River. In the plains region of the state, many small communities are able to obtain adequate water from shallow alluvial wells near rivers or large creeks, and many individual households still rely on the upland shallow aquifer even though it yields only very small amounts of water.

In the Ozarks, ground water yields are usually large and of excellent quality. Unlike cities in other areas of the state, many Ozark municipalities pump ground water directly into their water supplies without treatment. However, the geologic character of the Ozarks, which includes an abundance of ground water, also includes the ability to funnel large amounts of rainfall and surface runoff to the ground water system. This can present problems with ground water quality because much surface water flows directly to ground water through cracks, fractures or solution cavities into bedrock with little or no filtration. Contaminants in leaking septic tanks, storage tanks and surface waters affected by domestic wastewater, animal feedlots and other pollution sources can move directly into ground water through these cavities in the bedrock.

Like the Ozarks, ground water in the southeast lowlands is abundant and of good quality. Unlike the Ozarks, some contaminants are filtered by thick deposits of sand, silt and clay as water moves through the ground water system. Thus shallow ground water wells are subject to the same problems as found locally in the Ozark aquifer, including elevated levels of nitrate or bacteria, and also in some areas low levels of pesticides, deep wells are generally unaffected by contaminants.

Shallow ground water in the plains of northern and western Missouri tends to be somewhat more mineralized and to have taste and odor problems due to high levels of iron and manganese. Like shallow wells in the southeast lowlands, wells in this part of the state can be affected by nitrates, bacteria or pesticides.

In urban areas, alluvial aquifers of large rivers such as the Missouri and the Meramec that serve water supplies have been locally contaminated by spills or improper disposal of industrial or commercial chemicals.

WELL CONSTRUCTION AND GROUND WATER QUALITY

Well water quality is greatly influenced by well construction. Public drinking water wells and many private wells are deep, properly cased and grouted. These wells rarely have contaminants. However, many private wells are shallow or not properly cased. These wells can be easily

contaminated by septic tanks, feedlots or chemical mixing sites near the well. Studies in Missouri have shown that two-thirds of wells contaminated by pesticides are less than 35 feet deep. The three most common problems in private wells are bacteria, nitrate and pesticides. It is estimated that about 30 percent of private wells occasionally exceed drinking water standards for bacteria, 30 percent for nitrate and about 5 percent for pesticides. State regulations include standards for construction and wellhead protection for all new wells.

MAJOR POTABLE AQUIFERS IN MISSOURI

The location of the major aquifers providing drinkable water in Missouri are shown below. The unconfined aquifers are those under water table conditions (the pressure at the water table is the atmospheric pressure). These unconfined aquifers tend to yield greater amounts of water, but are also more easily contaminated by activities occurring at the land surface. In confined aquifers, the upper level of the saturated zone is restricted so that the pressure level is greater than exists at that level of saturation. Confined aquifers are generally recharged more slowly than unconfined aquifers but are better protected from surface contaminants.

Glacial Till Aquifer

This aquifer covers most of the Missouri north of the Missouri River. Glacial till is an unsorted mixture of clay, sand and gravel with occasional boulders and lenses of sand or gravel. Loess, fine wind-blown silt deposits of four to eight feet in depth, cover the till on the uplands. In places, the till is underlain by sorted deposits of sand or gravel. Although this aquifer is unconfined, surface water infiltrates very slowly, and ground water yields are very small. In scattered areas the till contains buried old river channels that remain as large sand or gravel deposits that hold much more ground water than the till. Some households still rely on this aquifer for drinking water, but it is inadequate as a source for municipal water supply.

Alluvial Aquifer

Alluvial aquifers are the unconfined aquifers on floodplains of rivers and are of Quaternary age. In Missouri, the largest of these aquifers lie along the Missouri and Mississippi rivers, reaching their widest extent in the southeast lowlands where they extend for as much as 50 miles west of the Mississippi River. Many small communities north of the Missouri River use the alluvial aquifers of nearby streams for their drinking water supply, and the Missouri River alluvium supplies the cities of Independence and Columbia and sections of St. Charles County. In the southeast lowlands, most private water supplies and about 45 percent of people served by public water supplies use water from the alluvial aquifer. Agricultural irrigation consumes about five times more water in this area of Missouri than does domestic water use. All agricultural irrigation water is drawn from the alluvial aquifer.

Wilcox-McNairy Aquifer

These two aquifers lie beneath much of the alluvial aquifer of the southeast lowlands. They are in unconsolidated or loosely consolidated deposits of marine sands and clays of Tertiary and

Cretaceous age. Except where the McNairy outcrops in the Benton Hills and along Crowley=s Ridge, these aquifers are confined. They yield abundant amounts of good quality water, and they provide the water for 55 percent of people served by public supplies. In the southeastern part of this region, the deeper of these aquifers, the McNairy, becomes too mineralized to be used for drinking water supply. These two aquifers appear to be unaffected by contaminants of human origin.

Ozark-St. Francis Aquifer

This aquifer covers most of the southern and central two-thirds of Missouri. It is composed of dolomites and sandstones of Ordovician and Cambrian age. Most of the aquifer is unconfined. This aquifer is used for almost all public and private drinking water supplies in this area of Missouri. Exceptions would include supplies in the St. Francis Mountains, such as Fredericktown and Ironton, where the aquifer has been lost due to geologic uplift and erosion, and in Springfield, where demand is so heavy that ground waters are supplemented with water from two reservoirs and the James River.

Yields and water quality are typically very good, but in many areas, the bedrock is highly weathered, contains many solution cavities and can transmit contaminated surface waters into the ground water rapidly with little or no filtration. Where the confined portion of the aquifer is overlain only by the Mississippian limestones of the Springfield aquifer, the confined Ozark aquifer continues westward for 80 miles or more as a potable water supply, serving the communities of Pittsburg, Kansas, and Miami, Oklahoma. However, where it is also overlain by less permeable Pennsylvanian bedrock, the confined Ozark becomes too mineralized for drinking within 20 to 40 miles.

The unconfined Ozark-St. Francis aquifer is susceptible to contamination from surface sources. Increasing urbanization and increasing numbers of livestock are threats to the integrity of portions of this valuable aquifer.

Springfield Aquifer

This aquifer covers a large portion of southwestern Missouri. It is composed of Mississippian limestones that are, particularly in the eastern portion of the aquifer, highly weathered. The aquifer is unconfined and surface water in many areas is readily transmitted to ground water. Urbanization and livestock production affect this aquifer. Elevated nitrates and bacterial contamination are common problems in ground waters of the Springfield aquifer.

GROUND WATER QUALITY SUMMARY TABLES

Table 10 lists the major sources of ground water contamination in Missouri, major contaminants and reasons why these sources are the most important. Table 11 summarizes groundwater quality problems as hazardous waste sites. Tables 12 and 13 provide information on levels of nitrate, pesticides and other toxic organics in public drinking water wells and Table 14 gives the present status of Missouri=s groundwater protection strategy.

TABLE 10. MAJOR SOURCES OF GROUND WATER CONTAMINATION

Contaminant Source	10 Highest Priority Sources (X) [1]	Factors Considered in Selecting a Contaminant Source [2]	Contaminants [3]
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots			
Drainage wells			
Fertilizer applications	X	A,C,D,E	E
Irrigation practices			
Pesticide applications	X	A,B,C,D,E	B
Storage and Treatment Activities			
Land application	X	A,D,E	J,K,L,E
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	X	A,B,C,D,E	D
Surface impoundments			
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills			
Septic systems	X	A,D,E	J,K,L,E
Shallow injection wells			
Other			
Hazardous waste generators			
Hazardous waste sites	X	A,B,C,D	B,C,H,I
Industrial facilities	X	A,B,C,E	E, Ammonia, PCP, Dioxin
Material transfer operations			
Mining and mine drainage	X	A,E	H
Pipelines and sewer lines			
Salt storage and road salting			
Salt water intrusion	X	C	G
Spills	X	A,B,C,E	B,C,D,Ammonia
Transportation of materials			
Urban runoff			
Other sources (please specify)			
Other sources (please specify)			

(1) Not in Priority Order
(2) Key: Factors Considered in Selecting Contaminant Source.
A. Human health or environmental toxicity risk
B. Size of population at risk
C. Location of sources relative to drinking water sources
D. Number and/or size of contaminant sources
E. Hydrogeologic sensitivity
(3) Key: Contaminants
A. Inorganic Pesticides
B. Organic Pesticides
C. Halogenated Solvents
D. Petroleum compounds
E. Nitrate
F. Fluoride
G. Salinity/brine
H. Metals
I. Radionuclides
J. Bacteria
K. Protozoa
L. Viruses

TABLE 11. GROUND WATER CONTAMINATION SUMMARY

Hydrogeologic Setting [1] All Aquifers
Spatial Description (optional)[2]
Map Available (optional)[3]
Data Reporting Period[4] 1996-97

Source Type[5]	Number of sites[6]	Number of sites that are listed and/or have confirmed releases[6]	Number with confirmed ground water contamination[6]	Contaminants[7]	Number of site investigations (optional)	Number of sites that have been stabilized or have had the source removed (optional)	Number of sites with corrective action plans (optional)	Number of sites with active remediation (optional)	Number of sites with cleanup completed (optional)
NPL	16	16	13	*4	18	11	10	8	2
CERCLIS (non-NPL)	51	47	22	*5	42	16	24	17	9
DOD/DOE	27	25	11	*6					
LUST	4,633	4,633	615	*1	4,232			1,213	3430
RCRA Corrective Action	30	24	24	*2	24	28	19	10	1
Underground Injection									
State Sites	125	88	44	*3	56	15	26	17	9
Nonpoint Sources[5]									
Other (specify)									

NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks
RCRA - Resource Conservation and Recovery Act

* Contaminants
- *1 - BTEX, TPH, MTBE, PAH, Metals, SVOA
- *2 - Creosote, penta, Organic Solvents, Petroleum, Asbestos, Metals, Chlorinated Solvents
- *3 - VOC, PAH, Chlorinated Solvents, Metals
- *4 - VOA, PCB, Pesticides, Dioxin, Metals, Radionuclides, SVOCs, etc.
- *5 - VOAs, SVOAs, PCBs, Dioxin, PAH, Pesticides, Metals
- *6 - Radionuclides, Metals, Semo-volatiles, Volatiles, Pesticides, Explosives

TABLE 12. AQUIFER MONITORING DATA

Hydrogeologic Setting [1] All Aquifers
Spatial Description (optional)[2] Statewide, most are in southern half of the state
Map Available (optional)[3]
Data Reporting Period[4] 1996-97

Monitoring Data Type	Total No. Of Wells Used in the Assessment [5]	Parameter Groups	NUMBER OF WELLS								
			No detections of parameters above MDLs or background levels		Nitrate concentrations range from background levels to less than or equal to 5 mg/1 No detections of parameters other than nitrate above MDLs or background levels and/or located in areas that are sensitive or vulnerable		nitrate ranges from greater than 5 to less than or equal to 10 mg/l Other parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs	Parameters are detected at concentrations exceeding the MCLs	Number of Wells Removed from service	Number of Wells Requiring Special Treatment	Background parameters exceed MCLs
			ND	Number of wells in sensitive or vulnerable areas (optional)	Nitrate ≤ 5 mg/l VOC, SOC, and Other parameters not detected	Number of wells in sensitive or vulnerable areas (optional)					
Ambient Monitoring Network (Optional)		VOC									
		SOC									
		NO_3									
		Other [15]									
Untreated Water Quality Data from Public Water Supply Wells		VOC									
		SOC									
		NO_3									
		Other [15]									
Finished Water Quality Data from Public Water Supply Wells	2909	VOC					7	1	1		
		SOC					2				
		NO_3	923		1971		12	3	1		
		Other [15]									

MDL = maximum daily level
MCL = maximum contaminant level
VOC = volatile organic compound
SOC = synthetic organic compound
NO_3 = nitrate
ND = not detected

TABLE 13. AQUIFER MONITORING DATA

Hydrogeologic Setting Ozark Confined
Spatial Description (optional) _____
Map Available (optional) _____
Data Reporting Period 1996-97

Monitoring Data Type	Total No. Of Wells Used in the Assessment [5]	Parameter Groups	NUMBER OF WELLS								
			No detections of parameters above MDLs or background levels		Nitrate concentrations range from background levels to less than or equal to 5 mg/1 No detections of parameters other than nitrate above MDLs or background levels and/or located in areas that are sensitive or vulnerable		Nitrate ranges from greater than 5 to less than or equal to 10 mg/l Other parameters are detected at concentrations exceeding the MDL but are less than or equal to the MCLs	Parameters are detected at concentrations exceeding the MCLs	Number of Wells Removed from Service	Number of Wells Requiring Special Treatment	Background parameters exceed MCLs
			ND	Number of wells in sensitive or vulnerable areas (optional)	Nitrate ≤ 5 mg/l VOC, SOC, and Other parameters not detected	Number of wells in sensitive or vulnerable areas (optional)					
Ambient Monitoring Network (Optional)		VOC									
		SOC									
		NO_3									
		Other [15]									
Untreated Water Quality Data from Public Water Supply Wells		VOC									
		SOC									
		NO_3									
		Other [15]									
Finished Water Quality Data from Public	38	VOC			29		9				
		SOC									
	172	NO_3	170		2						

Water Supply Wells		Other [15]									

MDL = maximum daily level
MCL = maximum contaminant level
VOC = volatile organic compound
SOC = synthetic organic compound
NO_3 = nitrate
ND = not detected

SUMMARY OF GROUND WATER PROTECTION PROGRAMS

TABLE 14. GROUND WATER PROTECTION STRATEGY

Program or Activities	Check (X)	Implementation Status	Responsible State Agency
Active SARA Title III Program	X		MDPS/SEMA
Ambient ground water monitoring system		NA	
Ground water monitoring at sanitary landfills	X	Fully established	DNR
Aquifer vulnerability assessment	X		DNR
Aquifer mapping		NA	
Aquifer characterization		NA	
Comprehensive data management system		NA	
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)		Under development	DNR
Ground water discharge permits	X	Fully established	DNR
Ground water best management practices (BMPs)	X	Continuing effort	DNR
Ground water legislation	X		DNR
Ground water classification		NA	
Ground water quality standards	X	Fully established	DNR
Interagency coordination for ground water protection initiatives	X	Fully established	DNR*
Nonpoint source controls		Continuing effort	DNR*
Pesticide State Management Plan		Pending	MDA
Pollution Prevention Program		Pending	DNR
Resource Conservation and Recovery Act (RCRA) Primacy	X	Fully established	DNR
State Superfund	X	Fully established	DNR
State RCRA Program incorporating more stringent requirements than RCRA Primacy	X	Fully established	DNR
State septic system regulations	X	Fully established	MDH
Underground storage tank installation requirements	X	Fully established	DNR
Underground Storage Tank Remediation Fund	X	Pending	DNR
Underground Storage Tank Permit Program		NA	
Underground Injection Control Program	X	Fully established	DNR
Vulnerability assessment for drinking water/wellhead protection	X	Fully established	DNR
Well abandonment regulations	X	Fully established	DNR
Wellhead Protection Program (EPA-approved)	X	Fully established	DNR
Well installation regulations	X	Fully established	DNR

MDPS/SEMA = Missouri Department of Public Safety, State Emergency Management Agency
MDA = Missouri Department of Agriculture MDH = Missouri Department of Health

Notes:

Active SARA Title III Program: Administered by Department of Public Safety, State Emergency Management Agency.

Ambient ground water monitoring system: There is no system per se. The state has participated in several opportunities to monitor ambient ground water, such as impact analyses following the floods of 1993.

Aquifer vulnerability assessment: These are conducted by the department=s Division of Geology & Land Survey on a county-by-county basis as funding allows.

Aquifer mapping and characterization: No present systematic activity, although these activities may be conducted in concert with hazardous substance release investigations.

Comprehensive data management system: None.

EPA-endorsed Core Comprehensive State Ground Water Protection Program: No formal program established.

Ground water discharge permits: Underground Injection Control permits issued jointly by the department=s Division of Geology & Land Survey and Water Pollution Control Program.

Ground Water Best Management Practices: Some BMPs are established as part of the Nonpoint Source Management Plan.

Ground water legislation: The Cave Resources Act and Clean Water Law deal directly with ground water. Other laws such as the dead animal disposal statute proscribe protections for ground water. There is no comprehensive ground water protection statute per se.

Ground water classification: None, although a utilities group proposed a classification system.

Ground water quality standards: Established as part of state water quality standards.

Interagency coordination for ground water protection initiatives: Opportunities for monthly coordination are provided through the Water Quality Coordinating Committee.

Nonpoint source controls: The nonpoint source management program provides guidance for voluntary controls.

Pesticide State Management Program: A draft generic pesticides and water quality management plan has been prepared by the Department of Agriculture in conjunction with DNR. The plan will address both ground water and surface water, and has been submitted to EPA for approval.

Pollution Prevention Program: Some activities carried out by one staff member in DNR=s Technical Assistance Program.

Resource Conservation and Recovery Act (RCRA) Primacy: Administered by the department=s Hazardous Waste Program.

State Superfund: Administered by the department=s Hazardous Waste Program. This provides for a state registry of confirmed abandoned hazardous waste disposal sites.

State RCRA Program: Incorporating more stringent requirements than RCRA Primacy: Administered by the department=s Hazardous Waste Program.

State septic system regulations: Administered by the Department of Health under 1994 statute and rules promulgated in 1995.

Underground storage tank installation requirements: Administered by the department=s Hazardous Waste Program.

Underground Storage Tank Remediation Fund: The existing insurance fund was converted to a remediation fund by 1995 statute; rules are being prepared.

Underground Storage Tank Permit Program: Tanks are required to be registered but not permitted.

Underground Injection Control Program: Administered by the department=s Division of Geology & Land Survey.

Vulnerability assessment for drinking water/wellhead protection: Administered by the department=s Public Drinking Water Program.

Well abandonment regulations: Administered by the department=s Division of Geology & Land Survey.

Wellhead Protection Program (EPA-approved): Administered by the department=s Public Drinking Water Program.

Well installation regulations: Administered by the department=s Division of Geology & Land Survey.

The significant additions or changes to the protection of ground water in the past four years are the passage of two statutes, SB 446 in 1994 and HB 251 in 1995. The former revised requirements for onsite sewage systems and the latter established a $100 million remedial fund for underground storage tanks. Each was a revision of an existing statute.

For more information, call the Department of Natural Resources at (573) 751-1300.